

FEMI 209: 200412

FLOOD INSURANCE STUDY

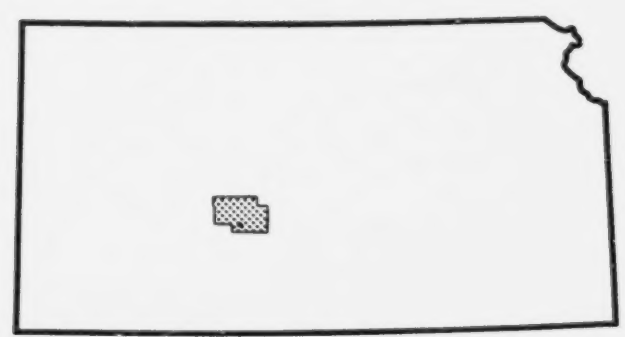


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CITY OF GARFIELD,
KANSAS
PAWNEE COUNTY



MAY 17, 1982



Federal Emergency Management Agency

COMMUNITY NUMBER - 200412

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

CITY OF GARFIELD, PAWNEE COUNTY, KANSAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Garfield, Pawnee County, Kansas, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Garfield to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Bucher and Willis, Consulting Engineers, Planners and Architects for the Federal Emergency Management Agency, under Contract No. H-4645. This study was completed in March 1980.

1.3 Coordination

The identification of streams requiring detailed study was accomplished in a meeting attended by personnel of FEMA; the Mayor of the City of Garfield; a representative of the Study Contractor; and a representative of the Kansas Board of Agriculture, Division of Water Resources (Ks. Bd. Ag. - DWR) on April 18, 1978. Subsequent coordination for this study included contact with the U.S. Geological Survey (USGS); the Department of Agriculture, Soil Conservation Service (SCS); the U.S. Army Corps of Engineers (COE), Albuquerque District; the Department of the Interior, Water and Power Resources Service (WPRS); the Kansas Water Resources Board (KWRB); the Ks. Bd. Ag. - DWR; and Evans, Bierly, Hutchison, and Associates, P.A.

On April 6, 1981, preliminary flood elevations, flood boundaries and floodway delineations were reviewed with representatives of the city, the Study Contractor and the Ks. Bd. Ag. - DWR at a technical meeting, in place of the intermediate meeting.

On October 27, 1981, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Garfield, Pawnee County, Kansas. The area of study is shown on the Vicinity Map (Figure 1).

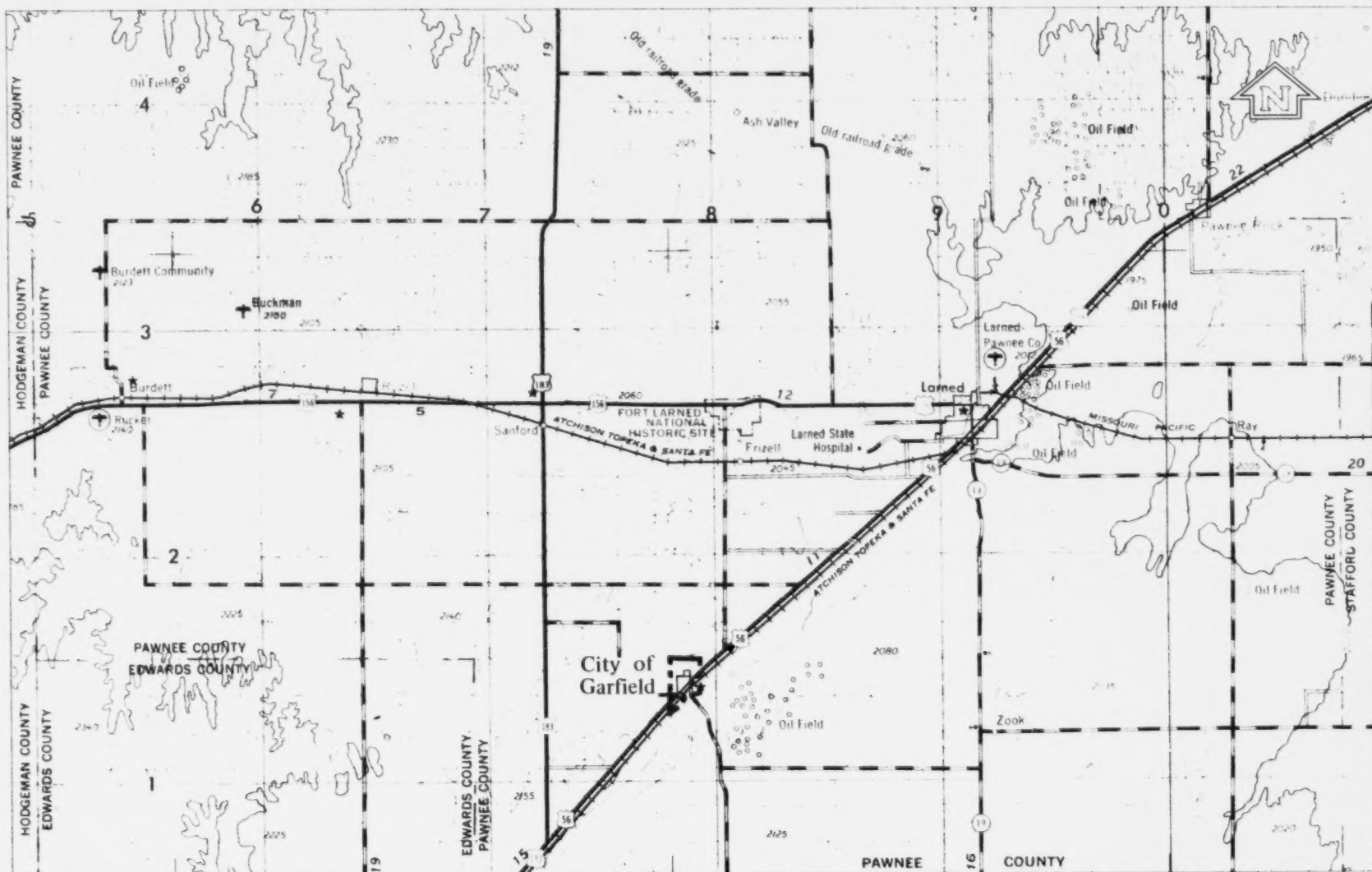
The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction for the next five years, through March 1985.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Garfield.

Floods caused by overflow of the Arkansas River Tributary (Garfield Drain) were studied in detail from the downstream end corporate limits to just downstream of the Sherman Street bridge. Flooding along Arkansas River Tributary (Garfield Drain) upstream of Sherman Street and Coon Creek were studied by approximate methods.

2.2 Community Description

The City of Garfield is located in south-central Pawnee County in central Kansas. Completely surrounded by unincorporated Pawnee County, the city is approximately 220 miles southwest of Topeka, 120 miles northwest of Wichita, and 51 miles northeast of Dodge City. According to the 1980 Census (Preliminary), Garfield's population is 277, which is an increase of 6.1 per cent from the 1970 Census figure of 261 (Reference 1). The City of Garfield is a small farming community along the banks of the Arkansas River.



FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GARFIELD, KS
(PAWNEE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

3

VICINITY MAP

FIGURE 1

In October 1872, three members of "The Volunteers Free Homestead Colony" of Geneva, Ohio selected the Camp Criley area as the location for the colony. Camp Criley, a supply camp named after Supt. J.D. Criley, was started by the Atchison, Topeka and Santa Fe Railway. In 1873, members of the colony filed on about 30 pieces of land and arrived to begin making improvements to the old campsite. A town was platted on December 8, 1873. The name was immediately changed from Camp Criley to Garfield in honor of James Garfield, Congressman from their old district in Ohio and later, President of the United States. Colonel H.P. Wolcott was general of the colony, and A.E. Smith built the first house on the townsite. The Atchison, Topeka and Santa Fe Railway located an experimental garden of forestry known as Forest Garden south of Garfield.

Garfield was incorporated as a city of the third class in Kansas in 1910 and adopted the mayor-council form of government (a mayor and five councilmen).

In the early 1960's, U.S. Route 56 was changed and several buildings were torn down so that the highway could go straight through the community (Reference 2).

The City of Garfield area has a temperate climate with a yearly precipitation from 7.97 inches in 1872 to 39.63 inches in 1915 with a yearly average precipitation of approximately 23.61 inches. The major portion of the yearly precipitation occurs as rainfall from April through October, with the heaviest amounts usually occurring from high intensity thunderstorms. Temperatures range from a high of 114 degrees Fahrenheit (F.) on July 31, 1934; August 13, 1936; July 11, 1954, to a low of -24 degrees F. on February 13, 1905 (Reference 3). The average winter and summer temperatures are 33.7 degrees F. and 78.1 degrees F., respectively, and the average annual temperature is 56.1 degrees F.

The City of Garfield is located on the flat upper alluvial plain along the north (left) bank of the Arkansas River and Coon Creek, which share a common flood plain in the area. The soils are typically deep, dark grayish-brown loams and fine sandy loams and pale-brown loamy fine sands, with depths of more than 36 inches to the secondary carbonate deposits (Reference 4). The average soil permeability is in excess of 4.0 inches per hour (Reference 5).

Both the Arkansas River and Coon Creek flow along the south edge of the City of Garfield. The Arkansas River begins on the eastern slopes of the Continental Divide in the Rocky Mountains near Leadville, Colorado. The Arkansas River Watershed includes Mount Elbert, highest point in Colorado, and above Garfield, Kansas the total drainage area comprises about 25,700 square miles, with about 6,000 square miles classified as noncontributing. John Martin Dam near Las Animas, Colorado controls about 18,130 square miles (Reference 6). Coon Creek has its headwaters in west-central Edwards County and joins the Arkansas River just south of the City of Garfield (drainage area not determined). The Arkansas River Tributary (Garfield Drain), which flows through Garfield from west-to-east, begins just west of the city and has a drainage area of approximately 2.22 square miles at Pawnee Street.

The existing development within the City of Garfield is mainly residential. The most probable area of new development would be to the north of the present community. Very little development is planned south of the Atchison, Topeka and Santa Fe Railway tracks.

Development within the flood plain in the City of Garfield is primarily residential.

2.3 Principal Flood Problems

The southern portion of the City of Garfield along the Arkansas River and Coon Creek, and south of the Atchison, Topeka and Santa Fe Railway tracks appears to be subject to flooding caused by overflow of these streams. A large portion of the remainder of the City of Garfield, due to the flat topography and small ditch capacity, would be subject to periodic flooding caused by thunderstorms in the immediate vicinity.

According to the SCS offices in Larned, Kansas, floodwaters from the Arkansas River and Coon Creek have never reached the residential portion of the City of Garfield, apparently the railroad track and highway have prevented it. The closest the water has ever come was during the 1965 flood (with a discharge of 42,600 cubic feet per second (cfs) and a recurrence interval of 170 years) but a section was cut through the county road south of Garfield to relieve the build-up and kept the city from flooding.

The Kansas Water Resources Board has a 1951 high water mark at the Arkansas River bridge, south of Garfield, near the Garfield sewage treatment plant. This high water mark (2072.0 feet National Geodetic Vertical Datum (NGVD)) would put the water-surface elevation very close to the elevation of U.S. Route 56 and the City of Garfield (high water mark was destroyed).

2.4 Flood Protection Measures

Presently, no flood protection structures exist within the City of Garfield or in the immediate vicinity.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 per cent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals

or exceeds the 100-year flood (on per cent chance of annual occurrence) in any 50-year period is about 40 per cent (four in ten), and for any 90-year period, the risk increases to about 60 per cent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

The discharges for the Arkansas River Tributary (Garfield Drain) were computed by several different methods to determine the procedure which best fits the stream and area. Because the terraced upper watershed discharges water onto a flat alluvial plain with ill-defined flow paths and high soil permeability, a method to account for these conditions was needed. A SCS method for estimating volume and rate of runoff in small watersheds (Reference 7) was finally selected. This procedure takes into account soil type, conservation practices, watershed slope, watershed drainage area and the 24-hour precipitation of the area. The 500-year discharges were determined by straight line extrapolation of the 10-, 50- and 100-year data plotted on logarithmic probability paper.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS)			
		10-YEAR	50-YEAR	100-YEAR	500-YEAR
ARKANSAS RIVER TRIBUTARY (GARFIELD DRAIN)					
Pawnee Street	2.2	425	756	852	1,100
Sherman Street	1.2	268	484	554	730

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross section data for the Arkansas River Tributary (Garfield Drain) were obtained by field survey methods with supplemental cross section data taken from topographic maps at a scale of 1:24000 with five and 10 feet contour intervals (Reference 8). Bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map.

Roughness coefficients (Manning's "n"), for the Arkansas River Tributary, (Garfield Drain) were estimated by field inspection and aerial photographs, scale 1:12000 of the Garfield area (Reference 9). For the Arkansas River Tributary (Garfield Drain), roughness coefficients for the main channel ranged from 0.040 to 0.050 and for the remaining portion of the flood plain the "n" values ranged from 0.055 to 0.070. Water-surface profiles were developed using a HEC-2 computer step-backwater program (Reference 10). Profiles were determined from the 10-, 50-, 100- and 500-year floods. The starting water-surface elevations for the Arkansas River Tributary (Garfield Drain) at the Atchison, Topeka and Santa Fe Railway tracks northeast of the City of Garfield were determined using the critical depth method at the downstream side of the railroad structure.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section;

between cross sections the boundaries were interpolated using USGS topographic maps at a scale of 1:24000, with contour intervals of five and 10 feet (Reference 8). Flood boundaries for the approximate study streams were determined from the City of Garfield Flood Hazard Boundary Map (Reference 11) using engineering judgment.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways for this study were normally computed on the basis of equal conveyance reduction from each side of the flood plain and engineering judgment, to try to maintain a 1.0-foot increase in elevation over the 100-year water-surface elevation. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2). Portions of the floodway extend beyond the city corporate limits.

As shown on the Flood Boundary and Floodway Map, the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
ARKANSAS RIVER TRIBUTARY (GARFIELD DRAIN)							
A	3440	134/50 ²	690	1.2	2072.0	2071.0	1.0
B	4212	90	546	1.6	2073.0	2072.0	1.0
C	4514	152	754	1.1	2073.1	2072.1	1.0
D	4852	170	782	1.1	2073.2	2072.2	1.0
E	5172	187	879	1.0	2073.2	2072.2	1.0
F	5659	91	393	1.4	2073.4	2072.4	1.0
G	6086	115	468	1.2	2073.7	2072.7	1.0
H	6366	136	472	1.2	2073.8	2072.8	1.0
I	6781	80	300	1.8	2073.9	2072.9	1.0

¹FEET ABOVE ATCHISON TOPEKA AND SANTA FE RAILWAY

²TOTAL WIDTH / WIDTH WITHIN CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GARFIELD, KS
(PAWNEE CO.)

FLOODWAY DATA

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ARKANSAS RIVER TRIBUTARY (GARFIELD DRAIN)

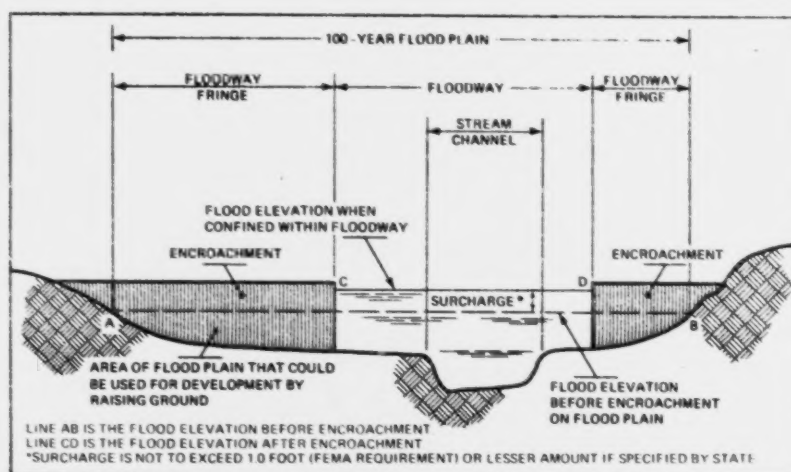


FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Garfield.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 per cent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the City of Garfield are shown on the Flood Profiles and are summarized in Table 3, "Flood Insurance Zone Data."

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF's are used to set actuarial insurance premium rate tables based on FHF's from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHF's, the entire incorporated area of the City of Garfield was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

- | | |
|----------|---|
| Zone A: | Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHF's determined. |
| Zone A2: | Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF. |
| Zone B: | Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided. |
| Zone C: | Areas of minimal flooding. |

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHF's, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Garfield is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

6.0 OTHER STUDIES

The Albuquerque District COE prepared a special flood hazard report along the Arkansas River and tributaries from Great Bend, Kansas to John Martin Dam, Colorado (Reference 6). This study shows the flood delineation for the Flood of Record (1965), Standard Project Flood (SPF) and Intermediate Regional Flood (IRF 100-year flood), and has the SPF flood profile for the Arkansas River. No Flood Plain Information report (FPI) has been prepared for the City of Garfield. The Special Flood Hazard Information (SFHI) tied together by river mile FPI flood profiles from several flood plain studies along the Arkansas River, and indicated that the SPF, IRF, and 1965 flood of record along the Arkansas River should only affect the undeveloped area south of the Atchison, Topeka and Santa Fe Railway tracks in the City of Garfield. The SFHI would not meet FEMA standards for detail study.

A Flood Hazard Boundary Map has been published for the City of Garfield (Reference 11). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 911 Walnut Street, Kansas City, Missouri 64106.

FLOODING SOURCE	PANEL ¹	ELEVATION DIFFERENCE ² BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION ³ (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
ARKANSAS RIVER TRIBUTARY (GARFIELD DRAIN) REACH 1	0001	-1.2	-0.4	1.1	010	A2	VARIES—SEE MAP

¹FLOOD INSURANCE RATE MAP PANEL

²WEIGHTED AVERAGE

³ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GARFIELD, KS
(PAWNEE CO.)

FLOOD INSURANCE ZONE DATA

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ARKANSAS RIVER TRIBUTARY (GARFIELD DRAIN)

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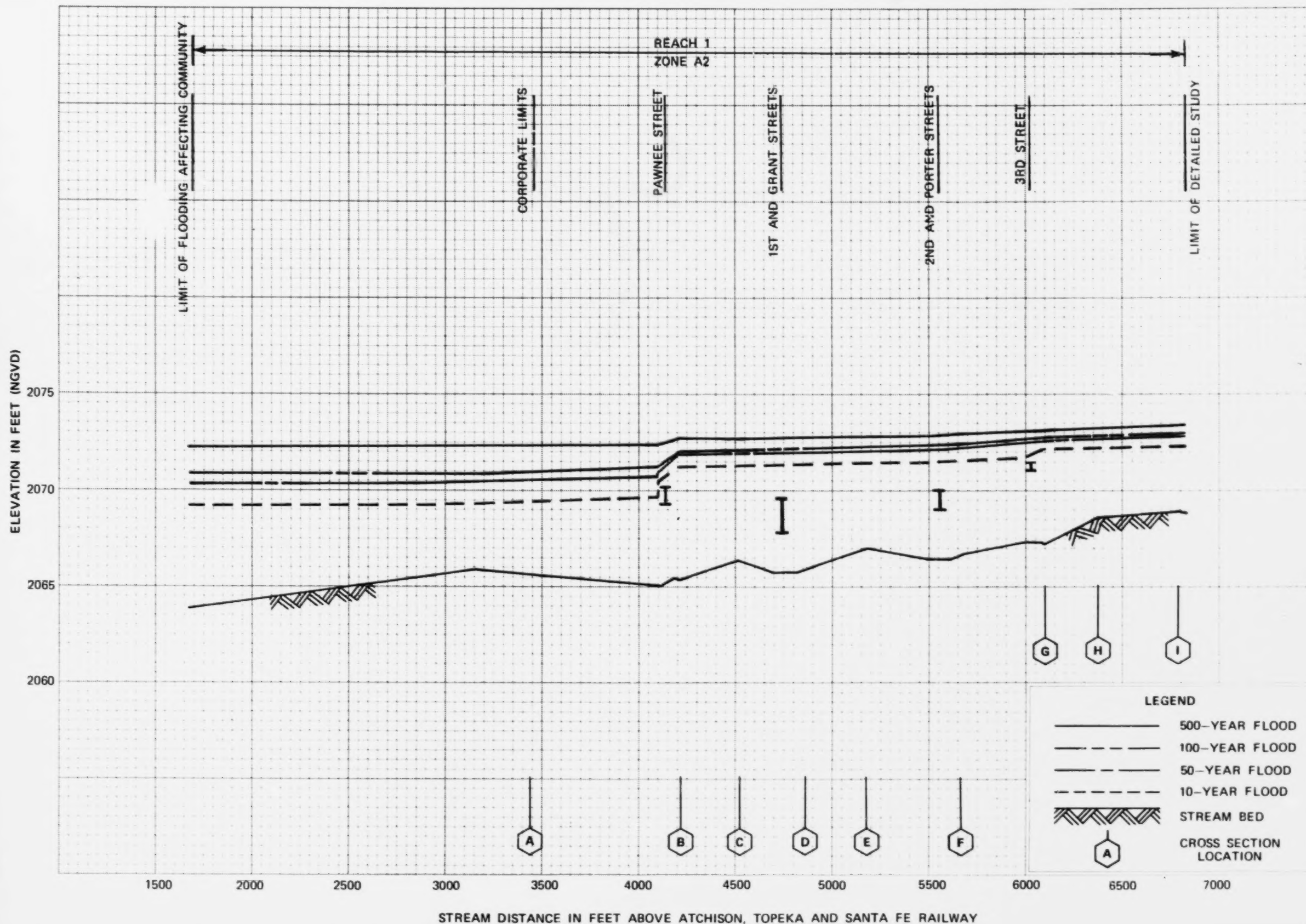
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FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF GARFIELD, KS
(PAWNEE CO.)

FLOOD PROFILES

ARKANSAS RIVER TRIBUTARY (GARFIELD DRAIN)

01P

BEST DOCUMENT AVAILABLE